THE ROLE OF THE STATE IN PROMOTING TECHNICAL PROGRESS

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For economies in the early years of transformation, questions of promoting technical progress have for understandable reasons not been at the top of the policy agenda. Urgent tasks of liberalisation, stabilisation, the reallocation of property rights and institution building in general, coupled with severe budgetary stringency and, in most cases, a sharp drop in the volume of fixed investment, have not been conducive to technological change. For the inherited national science and innovation system issues of survival have been the predominant concern. As the transition economies resume growth, the necessity of raising productivity and competitiveness has become a higher priority, although for Russian, Ukraine and other CIS economies this stage has only just begun or still lies in the future. In this paper the Russian Federation, the case with which the author is most familiar, will be drawn on for illustrative purposes.

Technical Progress, Innovation and Transition

An unfortunate legacy of the socialist planned economies is a tendency to adopt a very narrow focus on the sources of economic growth. In the Soviet Union scientific and technical progress, generally seen almost exclusively in terms of industry, was always seen as the key to higher productivity and growth. These were "over-industrialised" economies, especially in the FSU, and it is not surprising that in most cases market transformation has led to a sharp drop in the share of industry in GDP, with a parallel increase in the share of the previously under-developed service sector. This structural change is helping to promote a broader understanding. What the transition economies require is productivity enhancing innovation, of which technical progress in but one form, and not only within industry and other "productive" sectors (in the old Soviet understanding) but also in services and the government sector. In the USSR and other socialist countries a linear view of technical change predominated. New technology was seen as the end product of a chain from basic research, to applied research, development and finally the "introduction" of new technologies into production. But as the former Russian science minister, Boris Saltykov, has correctly observed, in the command economy it was not applied research, but "ministerial" science (Saltykov, 1997). Innovation was seen as synonymous with research and development, and thinking

about this tended to be focused almost exclusively on issues of policy for the support and management of scientific activity, organised on the ministerial principle.

In the author's view the appropriate focus for the transition economies should now be innovation understood in generous terms, embracing not only technical progress in industry and other sectors of the economy, but productivity enhancing change in general, including innovation in institutions, management and administration, social practices and communications. The task of the state above all is to assist in the creation of conditions in the economy and society conducive to rapid and successful innovation. This does not mean that there is no place for state involvement in the sphere of science, technology and innovation, but there is a need to reconsider the nature of that involvement, especially in the transitional economies where the state until recently was all-pervasive.

Survival and Spontaneous Adjustment

The experience of the Russian Federation has exemplified the processes of spontaneous adjustment in the sphere of science and technology which have characterised the economies in transition. For the vast network of research institutes of the Academy of Sciences and the "branch" system, the R&D establishments of the old industrial and other branch ministries (now almost extinct), short-term survival has been the overriding concern. This has generated an extraordinary range of responses, often of an enterprising character, including pursuit of new forms of funding, links with foreign partners, the renting of premises as office space for the domestic and foreign business sector, and the privatisation of facilities in attractive locations in the hope of future gain on the emergent property market. Many individual scientists and technical personnel have simply left to find their fortunes in the new business sector, in particular in banking and finance. From the point of view of the development of a flourishing market economy in Russia, this cannot be considered a negative development, especially in circumstances in which the science system inherited from the Soviet era was simply too large to be sustained in the new conditions. Indicators of the contraction of the Russian research system are shown in Table 1 below:

Table 1 - R&D Spending and Personnel in Russia, 1991-97

	1991	1992	1993	1994	1995	1996	1997
Expenditure on R&D as a %age of GDP	1.43	0.74	0.77	0.84	0.73	0.86	1.23
R&D personnel ('000)	1,678	1,533	1,315	1,106	1,061	991	946
- including researchers ('000)	876	804	645	525	-	485	463

Source: Goskomstat (1998),p.18; Goskomstat (1997),p.502; Gokhberg (1996), p.43.

It is worth noting that the 44% reduction in the number of R&D personnel between 1991 and 1997 is in line with the expectations of the OECD 1993 survey of Russian science, technology and innovation policy (OECD, 1993, p.17). The rate of decline is now declining and a new stable state can be expected within the next one or two years.

Another significant aspect of survival strategies adopted within the sphere of science has been the major advance in terms of internationalisation. During the years of the communist regime international scientific exchange was strictly controlled and on a very limited scale. Since 1991, without any state intervention, many Russian scientists, natural and social, have spent time working abroad, participated in international conferences and been published in leading journals. For the younger generation of Russian scientists this has become normal and they now for the first time consider themselves to be equal participants within the international scientific community. This is a development of major importance for the future of science in the countries in transition. Contrary to initial fears, the international "brain drain" has been relatively modest and many scientists now working abroad maintain contact with their colleagues in Russia.

Sources of Economic Growth

In recent years understanding of technical change and innovation has undergone significant development. Two important influences can be identified. Firstly, the development of an extensive literature on national systems of innovation. This has highlighted the diversity of institutional arrangements and government policies promoting the development of science and innovation and the absence of any single model that will secure success (see, e.g. Nelson (ed.), 1997). Secondly, the development of neo-Schumpeterian, evolutionary perspectives, including advances in endogenous growth theory. The latter has to some re-focused attention on the appropriate role of the state, in particular its role in securing the development of human capital, and the importance of promoting a general economic environment supportive of entrepreneurial activity, competion and innovation (see, e.g. Aghion and Howitt, 1998; Barro and Sala-i-Martin, 1995; Lucas, 1988). From this perspective innovative activity is seen as heterogeneous, R&D being one important form, but by no means the only one. It has also served to counter a one-sided emphasis on capital investment as the principal source of economic growth (see Nelson and Pack: 1998 for an interesting comparison between "accumulation" growth theories, granting a central role to investment, and "assimilation" theories, highlighting entrepreneurship, innovation and learning, in explaining the Asian "miracle").

In the author's view it precisely in the direction indicated by "assimilation" theories that the governments of the transformation economies should go if they wish genuinely to promote innovation and technical progress. At the same time, there is a need to move beyond modes of thought characteristic of the socialist

order, in particular a tendency to regard the state as the principal actor in securing the development of science and technology. To some extent these traditional attitudes are exemplified in the "Conception of the reforming of Russian science for the period 1998-2000", adopted by the Russian government in May 1998. This policy document represents a curiously eclectic mix of old and new thinking. The state role is conceived as all-embracing and hyper-active, with only passing reference to the existence of the market. Moreover, the "state" is invoked as a subject without reference to specific government agencies. Only a brief section towards the end of the document is devoted to the promotion of innovation, and even here confidence is undermined by the use from the outset of the term "*vnedrenie*", introduction, the term employed in the Soviet times to denote the transfer by administrative means (i.e. by the "plan") of research results generated within the organizationally isolated R&D institutions to the separate enterprises of industry.

Conceptions of this character overlook a crucial point: in the Russian Federation and in the CIS in general, but to a lesser extent in most CEE countries, the state's capacity to play an active role in promoting scientific and technical progress is limited, not only by severe budgetary stringency but also by low levels of administrative competence, discipline and ability to enforce policies and laws adopted. In short, the state is being asked to undertake tasks that it is not able to fulfil, tasks which may be better fulfilled by non-state bodies. By promoting non-state solutions, the state will help to foster an active civil society and social capital in general, and thereby enhance the social climate for successful innovation.

From the perspective of endogenous growth theory, the enhancement of human knowledge and skills, as much by learning by doing as by formal training, is a vital factor in the promotion of innovative activity. In the conditions of the planned economy, learning by doing was not considered important and the institutional framework was not one in which it could develop. With the consolidation of new ownership relations and the market, the situation is changing.

The focus on human capital may assist in a reconsideration of the educational legacy of the Soviet system. It has become a cliche of discussion of the prospects of the Russian economy that the country possesses a highly educated labour force. However, it tends to be overlooked that a very high proportion of the graduate labour force in Russia consists of engineers, the majority products of narrowly specialised "branch" technical institutes (see also Kennaway, 1997). Such graduates, it can be assumed, lack the adaptability so vital for a dynamic, innovative economy (see Aghion and Howitt, 1998, pp.174-5). One factor which may counter this negative assessment, however, is the periodic retraining and upgrading of specialist skills that was a feature of the Soviet system, which may mean that there is some potential for the acquisition of new skills.[1] But the proportion of graduates with a full university education, or experience of the top, high quality, technical institutes, is relatively small, and a disproportionally

large role is being played in the emergent market economy by this relatively small "layer" of the Russian population. A serious gap in the Soviet system was the lack of training for market conditions of managers, accountants, bankers and legal specialists. The Russian higher education system is beginning to adapt to the new conditions, but much needs to be done and more state funding will be essential to upgrade many higher educational establishments when budgetary conditions improve.

The Soviet economy, dominated by vast administrative bureaucracies and large-scale state enterprises, exhibited a striking lack of flexibility (see Killick, 1995, for the importance of "flexibility" in modern economies). The development of the market will not automatically ensure the emergence of a more flexible and adaptive economy friendly to innovation. Government action will be essential to promote competition, regulate natural monopolies, facilitate new business creation, and to prevent the state, both national and local, from smothering business activity.

Transitional Solutions

Economies in transition, especially if the pace of transformation is slowed by irresolute government action or political obstruction, throw up a variety of transitional institutions and practices which may frustrate and distort the development of genuinely market-oriented institutions and behaviour. Not surprisingly, such transitional forms may build on practices, skills and relationships found to be effective in the old regime. In particular, Soviet era network capital still plays a large role in the Russian Federation: enterprises and organisations are reluctant to break up old and trusted network links which help to secure collective survival in the new conditions. But such conservative networks inhibit change and innovation (see Harter, 1997, for an fruitful application of network theory to Russia's transition; also, more generally, Grabher and Stark, 1997). In the emergent "network society" (Castells, 1996), old Soviet-style networks can only impede innovation and growth.

In relation to innovation a particular obstacle in Russia is the fragmentation of the R&D system, a legacy of the previous order which to some extent has been reinforced by developments during transition. In the Soviet economy many research institutes and design organisations were organisationally independent from enterprises, or linked to them within such structures as "science-production associations". Administrative, planning relations substituted for the contractual relations found in a market economy. With privatisation this fragmentation became even more pronounced as most "science-production associations" were broken up and the member organisations privatised separately. To some extent inherited network relationships have served to maintain links, as have the development of such lose forms of integration as the "financial-industrial group", but as market relations take deeper hold it is likely that the problem of incomplete

contracts will become increasingly severe (see Aghion and Howitt, 1998, p.453), promoting the incorporation of R&D organisations into industrial companies, although the experience of the Russian aviation industry, where attempts to create integrated companies (MiG and Sukhoi) have been frustrated by conflict between the enterprises and the hitherto dominant design organsations and their leaders, who enjoyed considerable influence in the old regime, indicates that this will not be a simple process.

An unfortunate legacy of the communist past is an enthusiasm for a certain type of "industrial policy", an enthusiasm sometimes boosted by misconceived Western advice. Industrial policy is conceived as being synonymous with state funded support for entire branches of industry, or individual enterprises, in the form of subsidies, grants or long-term loans on preferential terms. The criteria for selection of branches or enterprises tend to be non-economic; lobbying strength and political influence often predominating. This approach to industrial policy is closely related to support for technical progress, as certain types of technology, generally those considered to represent "high technology", are selected by opaque procedures and criteria for privileged state funding by means of special government programmes. In the author's view, it has not been entirely negative that very severe budgetary constraints during transition have restricted the Russian government's scope for the pursuit of such industrial and technical policies, many special programmes remaining merely as declarations of intent. In the conditions of a still emergent market, with many serious distortions, including widescale barter and massive inter-enterprise arrears, there are no economic criteria for selecting the recipients of such forms of state support, and the hope must be that as market distortions diminish and the state's budgetary capacity improves, enthusiasm for this old style industrial policy will wane. Better acquaintance with foreign experience may also assist: Richard Nelson in his conclusion to a major study of national innovation systems concluded that there was a tendency to exaggerate the role and extent of coherent national industrial policies, with little evidence of successful government promotion of high technologies, with the exception of some largely "infant industry" cases (Nelson, 1993, pp.515-517). The "lure" (Nelson) of "high tech" is probably one that Russia and other transitional economies would be well-advised to resist.

The Challenge of Globalisation

The historic process of post-communist economic transformation is unfolding at a time of rapid economic, cultural and informational globalisation from which the former planned economies cannot remain immune. Evidence of the extent to which they are now part of the global order is provided by the dramatic and immediate impact of the Asian financial crisis on Russian and other transition economies. The impact of globalisation on technical change is itself a topic of lively debate: does it signal the curtailment to a large degree of the role of the

national state in the support and promotion of science, technology and innovation; or will the national state retain an important role, albeit different from that traditionally pursued (see Archibugi and Michie (eds.), 1997, for an insightful review of the issues). In the author's view the latter is probably correct.

For transitional economies such as the Russian Federation, it is clearly of considerable importance for the state to foster conditions conducive to a more substantial flow of inward direct investment, more joint ventures and strategic technology alliances. These forms of international technology transfer and cooperation are developing, but the potential is far from being fully realised. (see Opitz and Sauer, 1997, Gonchar, 1997, Sedaitis (ed.), 1996, and Bzhilianskaya, 1997). Above all, the maintenance of a relatively open economy is a vital condition for Russia and other transitional economies to take advantage of the new possibilities opened up by trends towards globalisation, but also openness in relation to human movement, information and scientific and cultural exchange. That such openness cannot be taken for granted is shown by the occasional threats in Russia to curtail open access to the Internet. But the role of commodity trade in the promotion of technical progress should not be overlooked: a recent study of the experience of the Czech Republic concluded that trade (imports) has been more significant since 1992 in boosting the productivity of enterprises than transfers of technology through direct investment (Djankov and Hoekman, 1998).

In Russia and other CIS member countries globalisation will require a revision of traditional attitudes to the acquisition of foreign technology. In Soviet times the outside world was regarded as a source of technologies to be copied or acquired on a one off basis in order to reproduce and develop them further using domestic R&D capabilities, although in practice the latter often proved impossible. This approach allowed the USSR to upgrade technology in a rather haphazard manner, but fated the country to lag permanently behind the world's best achievements (see Bernshtein, 1998). What was lacking was any lasting partnership with foreign companies for genuinely joint work for the development of technologies and innovation. There are signs of change, but it may take some time to adapt to the new opportunities (and threats) posed by globalisation.

Civil-Military Integration and Dual-Use Technology

The Russian Federation, and to a lesser extent Ukraine, Belarus and other CIS and CEE countries, has the difficult legacy of a very large, previously privileged military sector. From 1989 attempts were made to convert part of the production and R&D capacity to civilian purposes, but with only very limited success. This policy failure has arisen not only from inadequate state funding, but from the very narrow and mechanical approach adopted to the civilianisation of the military sector: "*konversiya*" has been seen simply as a direct switch of industrial capacities, equipment, premises and personnel from military work to civilian, rather than as a more fundamental reallocation of resources in the economy. In the event, since

1991 the Russian defence industry has downsized to a substantial degree by spontaneous adaptation to sharply reduced domestic weapons procurement and other forms of state funding, and the industry's human resources have been reallocated by market forces: under-employed and under-paid personnel, especially those with entrepreneurial talents, have left to enter the new business sector or other forms of employment. This rapid contraction of the defence industry (shown in Table 2) has been a spontaneous process driven to a large extent by market forces, including the spin-off from large companies of small high technology businesses. The example of Zelenograd, the Soviet Union's own "Silicon Valley", provides an illustration of positive processes of adaptation now underway. Employment at the formerly state-owned institutes and enterprises has contracted dramatically, but many new small businesses have emerged in the field of microelectronics and information technology. At the same time, some of the institutes and companies, now privatised and much reduced in scale, have begun to adapt to the new market conditions and have found ways of developing new export possibilities, often in cooperation with foreign firms. This is precisely the form of "conversion" that holds some promise of success, driven not by state programmes and funding, but by grass roots adaptation promoted by market forces and new forms of ownership.

Table 2 - The Defence Industry of the Russian Federation, 1991-97 (1991=100)

	1991	1992	1993	1994	1995	1996	1997
Total Output - including:	100	80.4	64.6	39.2	31.2	22.7	19.0
- military	100	49.5	32.5	19.9	16.6	12.8	8.8
- civilian	100	99.6	85.6	52.6	41.3	29.1	27.8
Total Employment	100	88.2	78.5	61.2	51.8	45.0	39.0

Note: Excludes the nuclear industry.
Source: http://server.vpk.ru/www-vpk/vpk/ (accessed March 1998).

In December 1997 the Russian government approved a strategy for the restructuring of the remaining facilities of the defence industry (excluding those of the nuclear sector). This envisages a further substantial downsizing, permitting many companies to leave the military sector and civilianise fully, if they are able to, but the retention of a "core" defence industry responsible for most development and production for domestic needs and arms exports, surrounded by associated companies devoted to dual-use technologies and high-technology civilian activities, and also small and medium sized enterprises and joint ventures. However, thinking about dual-use technologies tends to be instrumental: there appears to be a hope that some of the cost of maintaining the defence industry's

R&D base can be off-loaded from the defence budget to the civilian science budget (Kontseptsiya restrukturizatsii, 1998).

This strategy represents a step forward in thinking about the reform of the military sector, but problems remain. There is still a desire to retain a specialised, distinct, core military sector of industry, whereas the trend in the USA and Western Europe is towards deeper civil and military integration, with a reduction in the scope of special military specifications, greater use in military production of commercial "off the shelf" technologies, and a transition to "smart" procurement procedures for both military and civil government orders (see CSIS (1998)). This strategy, eroding the distinction between military and civilian activities, offers more scope for the development of genuinely dual-use technologies, and if pursued with commitment over a period of time could lead to the emergence of an integrated high-technology research and industrial base able to produce for both military and civil needs.

Is Innovation Taking Place?

In Russia, as in other transition economies, the inherited industrial base has contracted but there has been rapid growth of new businesses, especially in the previously underdeveloped service sector. This situation, it could be argued, presents some challenging opportunities to the transition economies: in many sectors there is a minimal "legacy problem". One is reminded of Veblen's classic analysis of the "penalty" paid by Britain for being the first country to develop a railway system, and the advantages that gave Germany and America when they embarked on a similar development at a later stage (Veblen, 1939, pp.130-132). Thus Russia and other transition economies have the possibility of leapfrogging stages of technical development, especially in IT and communications, including the technologies associated with the newly developing service sector activities. This is already happening: Russia and other economies of the region are achieving very high rates of growth in the adoption of the latest technologies. In this development the newly emergent business sector is playing a leading role. Unfortunately, the modernisation of the systems of statistical reporting is often not keeping up with these significant new trends.

According to the Russian statistical agency, Goskomstat (and the Ministry of Science and Technology, responsible for science statistics) very little innovation has been taking place since 1991. The indicators employed are almost unchanged from Soviet times: the number of enterprises "introducing new technology" in a given period, the proportion of new products, etc. In the author's view, the impression created is often seriously misleading and there is an urgent need for a radical reconsideration of statistical categories and the methods of data collection. One of the principal shortcomings is an inadequate coverage of developments in the new private sector of the economy. Often more useful now are the surveys undertaken by businesses, consultancy organisations and others involved directly with innovation. They can provide a very different picture, at times indicating very rapid change in

technologies, skills and knowledge of a kind that offers the prospect of a more dynamic economy in the future. But from the perspective of the enhancement of human capital, the importance of changes in the sphere of consumption should also not be underestimated. As Dyker has correctly observed, the "technological level of a society is at least as much a function of the technology of consumption and lifestyle as of the technology of production", indeed, he has argued that such "soft" technology "may, in conditions of transition, be a much more critical dimension than that of 'hard' technology" (Dyker, 1997, p.17; see also Zacher, 1997). From this perspective, the very rapid growth in the number of Internet users, dramatically increased foreign travel, widened ownership of cars, videos and other high-technology goods, acquaintance with the latest technology and management practices of the banking and retail sectors, and even personal experience for the first time of a hitherto inaccessible range of foreign consumer goods, can all be regarded as contributing to human capital and at least indirectly to the innovative potential of society. It is the younger, more highly educated section of society that is likely to be affected to the greatest extent, but this holds promise for the future. Some indication of these developments is provided by Table 3. It must be emphasised, however, that some of the data are approximate and provisional.

Table 3 - Some Indicators of Change in the Russian Federation, 1991-98

	Beginning of transition	1997-98
1. Number of Internet users	-	600,000 - 1,660,000
2. Production of personal computers (units)	254,000	1,400,000
3. Cellular mobile phones: number of subscribers	300	495,000
4. Pagers: number of subscribers	n.d.	300,000
5. Number of fax machines in use	6,540	70,500
6. Passenger cars per 1000 population	56	110
7. Russians travelling abroad (000)	4,150	21,331 (95)

Sources:
1. *Russian Review*, 19 June 1998, p.30 (estimates of Russian Centre for Internet Technologies (1997) and Samovar Internet Consulting (1998)).
2. *Finansovye izvestiya*, 16 April 1998, p.5 (note: 1997 data of IDC company; 1991, of Goskomstat; for 1997 Goskomstat gives an output of only 144,000).
3. 1991, *UN Statistical Yearbook 1996*; December 1997, *Delovye lyudi*, May 1998, p.103.
4. Early 1998, *Delovye lyudi*, May 1998, p.111.
5. 1991, *UN Statistical Yearbook 1996*; Goskomstat (1996), p.610.
6. 1990, Goskomstat (1994), p.202; 1997, *Kommersant-Daily*, 3 June 1998.
7. World Tourism Organisation, *Compendium of Tourism Statistics, 1991-1995*, 1997, p.145

Thus, even in the difficult conditions of the Russian economy since 1991, innovation is taking place and while the overall volume of investment remains low, investment in some forms of high technology is growing rapidly, e.g. it is estimated that sales of information technology in Russia reached some US$3.5bn

in 1997 (see "IT revolution invades Russia", *Russian Review*, 19 June 1998, p.26). The collapse of output of many products has also led to the retirement of obsolete capacities, raising the share of more progressive production technologies. This can be illustrated by the steel industry: the share of oxygen converter and electric arc steel in total steel output has risen from 47% in 1990 to 68% in 1997. (Goskomstat, 1997, p.353)

There are also clear signs of the beginnings of a revival of activity in the sphere of R&D: as shown in Table 1, in 1997 the GDP share of total spending on R&D increased to 1.23%, compared with only 0.72% in 1995. Moreover, in 1997, 72% of R&D was performed within the business sector, and the share of the federal budget in total funding was 47%, compared to 90% in 1994, providing evidence of some successful adaptation to the new conditions (Goskomstat, 1998, p.18).

Conclusion

The principal prerequisites for innovation are competition and a flexible, open economy, plus conditions as favourable as possible to new business creation. From this perspective, the priority for the state should be the promotion and maintenance of these framework conditions, but also support for the development of human capital, free flows of information and, on a selective basis with a keen appreciation of the need for an efficient use of resources, support for basic research and some directions of applied R&D in which the country has some competitive advantage or which are considered vital for the country's national security. In underwriting fundamental research on a selective basis in those countries which had independent Academies of Sciences prior to transition, it would be advantageous to promote the integration of academic institutes and universities and other higher educational establishments.

But the central, crucial, role of the state in securing innovation is the promotion of a favourable overall economic environment. Above all this means the fostering of stable economic institutions working within and promoting the rule of law, the active promotion and maintenance of competition and an open economy, and the development of appropriate forms of regulation, minimising the role of, and scope for, arbitrary direct state intervention. A more stable business environment should create conditions favourable to increased capital investment, longer-term lending by banks and the development of venture capital to support new developments and innovation. Also beneficial to these processes would be legislation permitting ownership of land by companies and individuals. In addition, in Russia and other countries there is much to be done to simplify greatly the creation of new businesses, eliminating complex and time-consuming registration procedures which not only frustrate entrepreneurial initiatives but provide countless opportunities for bribery and corruption. In Russia there is also an urgent need to simplify the tax regime for SMEs.

A learning process is underway, one in which the states of the transitional economies, all powerful in the previous order, are gradually becoming aware of the limits to their power and competence in the new conditions of the market and democracy. In Russia and many other post-communist countries it will take many years to establish a new relationship between the state and the newly emergent civil society, but the pursuit of active policies to achieve this goal may well be the most effective route towards the creation of an innovative, dynamic economy.

Note

1. The author is grateful to Rostislav Kapelyushnikov for this observation.

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